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ABSTRACT

During the 1984-85 school year, questionnaires were mailed to 358 science teachers in all regions of North Carolina to determine what they thought about the value of laboratory activity as one of their teaching methods and their feelings about the mechanics of using this methodology. Without a follow-up, 52.2 percent (N=187) of the questionnaires were completed and returned. Results are presented and discussed as related to nine questions asked. Areas explored in these questions include actual and ideal time for teaching methods (demonstrations, discussion/oral reports, in-class paper work, laboratory, or lecture), whether students change as a result of laboratory work, major impediments to laboratory work, effectiveness of laboratory work compared to demonstrations on the same topic, time per week devoted to laboratory (hands-on) work, money spent per pupil on laboratory supplies, equipment and materials, and how much money, per pupil, is reasonable for these items. Among the findings reported are those indicating that only 40.7 percent feel that their students "learn a lot" in the laboratory and that 83 percent uses laboratories less than 30 percent of the time (45 minutes or less per week). (A copy of the questionnaire is included.) (JN)

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The Science Laboratory

Research Report Number Six

University of North Carolina

Chapel Hill

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August 1985

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Research Report Number 6

The Science Laboratory

University of North Carolina - Chapel Hill
Summer 1985

We wanted to find out what the science teachers in North Carolina thought about (1) the value of laboratory activity as one of their teaching methodologies and (2) their feelings about the mechanics of using this methodology. Through the Network[1], an inplace random sample of science teachers (see Research Reports No. 1 and 2) were asked to respond.

During the 1984-85 school year, questionnaires were mailed to 358 science teachers in all regions of the state. Without a follow-up, 52.2% (187) of the questionnaires were completed and returned. Results were compiled and analyzed during the late spring and summer of 1985 and are presented below.

Science teachers in North Carolina are guarded in their claims for the impact of laboratory activity in their classrooms. Only 40.7% feel that students in their classes "learn a lot" in lab and even then they estimate that only 60% fall into this category. In other words, in a class of 30 students, 18 would increase their knowledge of the subject a lot. Some two thirds (65.5%) do believe, however, that only less than a fifth "learn very little" in lab. Apparently they feel that some 80% of the students do gain something in the realm of "knowledge."

More teachers do feel that students increase lab skills but even this is far from resounding. Close to 50% (47.7%) feel that 60% of their students "increase lab skills a lot" with almost three fourths (72.3%) feeling that some 80% of their students do gain some laboratory skills from lab activity.

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[1] "The Science Education Information Network: A Rapid Response Opportunity for Teachers." Science Education, 69 (2), April, 1985.

Attitudes appear to be more influenced by lab work than either "knowledge" or "skills" but, once again, not to an overwhelming extent. Fifty four percent (53.7%) of the teachers think that 60% of their students "seem to improve their attitudes a lot" while some 75% (73.4%) feel that 80% seem to improve their attitudes to some extent.

The use of laboratory activity with their classes seems to reflect their uncertainty about its value overall. Eighty three percent (83.1%) use labs less than 30% of the time: in a 50-minute period 5-day week, this would be 45 minutes or less per week. Almost 15% of the teachers use less than 10% of class time for labs--15 minutes a week. Under ideal conditions, though, more teachers would use labs but, even so, 38.4% would use them less than 30% of the time!

While teachers report that they spend about a period per week in lab, they say they think 98 minutes (almost 2 periods) a week would be most beneficial. When asked to compare the effectiveness of lab work to demonstrations, 29.4% of the teachers said that for nearly all topics, lab is more effective; 62.1% said that for many topics, lab is more effective; and 12.4% said that lab work is more effective for few topics.

Why do teachers feel this way about labs? Forty four percent (43.5%) reported "increased discipline encounters" as a major problem and only 14.7% said this was no problem. The remaining teachers (41.8%) consider this a "minor problem." Forty percent said that "teacher strain" is a major problem but 21.5% said this is "no problem" while 38.5% consider teacher strain a minor problem. Safety factors were considered by 36.7% of the teachers as a major problem, by 53.1% as a minor problem, and by 10.2% as no problem. The fourth factor in importance is "amount of trouble" and 32.7% reported that this is a major problem, 52.6% said it is a minor problem, while 14.7% said it was

no problem. Other "impediments" to laboratory activity as perceived by the sample group were: expendable laboratory supplies (23.2% - major problem); laboratory facilities (21.5% - major problem); length of class period (14.7% - no problem); class size (10.2% - no problem) and non-expendable laboratory equipment (10.2% - no problem).

Teachers in the sample seemed to have problems with financing for lab supplies, equipment and material. Thirty six percent (36.2%) said that they could not estimate how much money they have to spend each year. Those who did respond estimated that they spent $4.50 per pupil per year but said that they needed $10.40 per pupil per year.

More detailed responses follow:

Question 1: How do you divide your instructional time each week? (Approximately)

a. demonstrations:

---nearly 90% (89.9%) of the teachers responding utilize demonstrations less than 20% of instructional time during any one week with 45% (44.7%) utilizing demonstrations less than 10% of the time.

---1.1% of the teachers utilize demonstrations for over 30% of the time.

b. discussion/oral reports:

---84.8% use these techniques less than 30% of the time and 31.1% use them less than 10% of the time.

c. in-class paper work:

---87.1% use this technique less than 30% of the time while 99.4% use it less than 50% of the time.

d. laboratory

---14.7% of the teachers utilize labs for less than 10% of the time.

---31.6% use labs 10% to 20% of the time.

---36.7% use labs 20% to 30% of the time.

---9.6% use labs 30% to 40% of the time.

---83.1% use labs less than 30% of the time.

e. lecture:

---61.6% of the teachers use lecture less than 50% of the time.

---22% use lecture 20% to 30% of the time.

---19.8% use lecture 50% to 60% of the time.

---9.1% use lecture over 70% of the time.

Question 2: Under <u>ideal</u> conditions, how would you divide your instructional time?

a. demonstration:

---81.9% of the teachers would use this methodology less than 20% of the time during any one week.

---3.6% would use demonstration less than 10% of the time.

---2.8% would use demonstration over 30% of the time.

b. discussion/oral reports:

---85.9% of the teachers would use these techniques less than 30% of the time and 23.2% would use these less than 10% of the time.

c. in-class paper work

---38.4% would use this technique less than 30% of the time while 100% would use it less than 50% of the time.

d. laboratory

---1.1% would use laboratory activity less than 10% of the time.

---6.8% would use labs 10% - 20% of the time.

---30.5% would use labs 20% to 30% of the time.

---22.6% would use labs 30% to 40% of the time.

---38.4% would use labs less than 30% of the time.

e. lecture

---95.5% would use lecture less than 50% of the time.

---26.6% would use lecture between 20% to 30% of the time.

Question 3: In your opinion, to what extent do you think students change as a result of hands-on laboratory work?

Knowledge

---40.7% of the teachers feel that 60% or more of their students "learn a lot" from laboratory work.

---22.6% feel that less than 20% of their students "learn a lot" from lab.

---21.5% feel that 60% or more of their students learn some.

---2.8% feel that 60% or more of their students "learn very little."

---65.5% feel that less than 20% learn some.

Skills

--- 47.4% of the teachers feel that 60% or more of their students "increase lab skills a lot."

---11.3% feel that less than 20% "increase lab skills a lot."

---13% of the teachers feel that 60% or more of their students increase "lab skills some."

---32.2% feel that less than 20% "increase lab skills some."

---.6% of the teachers feel that 60% or more of their students increase lab skills "very little."

---72.3% feel that less than 20% increase lab skills "very little."

Attitudes

---53.7% of the teachers feel that 60% or more of their students seem to improve their attitudes about the subject "a lot."

---13% feel that less than 20% seem to improve their attitudes "a lot."

---9.6% of the teachers feel that 60% of more of their students seem to improve their attitudes about the subject "some."

---37.3% feel that less than 20% seem to improve their attitudes "some."

---2.2% of the teachers feel that 60% or more of their students seem to improve their attitudes about the subject "very little."

---73.4% feel that less than 20% seem to improve their attitudes "very little."

Question 4: What are the major impediments in your situation in regard to laboratory activity for students?

class size

---10.2% reported class size as a "major problem"

---62.1% said "no problem."

laboratory facilities

---21.5% reported facilities as a "major problem."

---33.9% said "no problem."

laboratory equipment (non-expendable)

---10.2% reported non-expendable equipment as a "major problem."

---38.4% said "no problem."

laboratory supplies (expendable)

---23.2% reported expendable lab supplies as a "major problem."

---26.6% said "no problem."

length of class period

---14.7% reported length of class period as a "major problem."

---46.9% said "no problem."

amount of trouble

---32.7% reported amount of "trouble" as a "major problem."

---14.7% said "no problem."

safety factors

---36.7% reported safety factors as a "major problem."

---10.2% said "no problem."

teacher strain

---40% reported teacher strain as a "major problem."

---21.5% said "no problem."

increased discipline encounters

---43.5% reported increased discipline encounters as a "major problem"

---14.7 said "no problem."

Question 5: The research on effectiveness of individual laboratory activity on a topic in comparison to demonstrations on the same topic shows mixed results. What do you think?

"Lab work is more effective for nearly all topics"

---29.4% of the teachers said "yes."

"Lab work is more effective for many topics"

---62.1% of the teachers said "yes."

"Lab work is more effective for few topics"

---12.4% of the teachers said "yes."

"Lab work is more effective for no topics"

---none of the sample said "yes."

Question 6: On the average, how much time per week do your students spend in laboratory (hands-on) activity?

0 - 19 minutes: 10.7% of the teachers

20 - 39 minutes: 21.5% of the teachers

40 - 59 minutes: 33.3% of the teachers

60 - 79 minutes: 15.3% of the teachers

80 - 99 minutes: 5.1% of the teachers

100 - 119 minutes: 9.6% of the teachers

Over 120 minutes: 4.5% of the teachers

Mean: 55 minutes per week

Question 7: How much time per week to you think would provide <u>maximum</u> <u>benefit</u> to your students?

0 - 19 minutes: 7.5% of the teachers

20 - 39 minutes: 1.7% of the teachers

40 - 59 minutes: 15.8% of the teachers

60 - 79 minutes: 13.6% of the teachers

80 - 89 minutes: 7.9% of the teachers

100 - 119 minutes: 21.5% of the teachers

120 - 139 minutes: 16.9% of the teachers

140^{+} minutes: 15.3% of the teachers

Mean: 98 minutes per week

Question 8: Can you estimate how much money, per pupil, that you have to spend each year for laboratory supplies, equipment and materials?

Yes: 63.8% (113)

No: 36.2% (64)

<u>Approximate amount</u>:

$1 to $2.99 per pupil: reported by 32.1% of the teachers

$3 to $4.99 per pupil: reported by 35.8% of the teachers

$5 to $6.99 per pupil: reported by 20.2% of the teachers

$7 to $8.99 per pupil: reported by 3.7% of the teachers

$9 to $10.99 per pupil: reported by 3.7% of the teachers

Over $11.00 per pupil: reported by 4.5% of the teachers

Average: $4.50 per pupil

Question 9: How much money, per pupil, would you think is <u>reasonable</u> for your present situation?

<u>Approximate amount</u>:

$1 to $2.99 per pupil: Reported by 3.7% of the teachers

$3 to $4.99 per pupil: Reported by 12.5% of the teachers

$5 to $6.99 per pupil: Reported by 27.2% of the teachers

$7 to $8.99 per pupil: Reported by 11.0% of the teachers

$9 to $10.99 per pupil: Reported by 21.3% of the teachers

Over $11.00 per pupil: Reported by 24.3% of the teachers

Average: $10.40 per pupil

APPENDIX

The Science Laboratory

I. How do you divide your instructional time each week?

a. demonstrations:

0 to 9% of the time:	44.7%
10 to 19% of the time:	45.2%
20 to 29% of the time:	9.0%
30% and over:	1.1%

b. discussion/oral reports:

0 to 9% of the time:	31.1%
10 to 19% of the time:	30.5%
20 to 29% of the time:	23.2%
30 to 39% of the time:	9.0%
40 to 49% of the time:	2.3%
50 to 59% of the time:	2.3%
60 to 69% of the time:	.6%
70 to 79% of the time:	0%
80 to 89% of the time:	1.1%

c. in-class paper work:

0 to 9% of the time:	23.2%
10 to 19% of the time:	34.5%
20 to 29% of the time:	29.4%
30 to 39% of the time:	7.9%
40 to 49% of the time:	4.5%
50 to 59% of the time:	0%
60 to 69% of the time:	.6%

d. Laboratory:

0 to 9% of the time:	14.7%
10 to 19% of the time:	31.6%
20 to 29% of the time:	36.7%
30 to 39% of the time:	9.6%
40 to 49% of the time:	5.1%
50 to 59% of the time:	1.7%
60 to 69% of the time:	.6%

e. Lecture:

0 to 9% of the time:	4.5%
10 to 19% of the time:	7.3%
20 to 29% of the time:	22.0%
30 to 39% of the time:	15.8%
40 to 49% of the time:	11.9%
50 to 59% of the time:	19.8%
60 to 69% of the time:	9.6%
70 to 79% of the time:	5.1%
80 to 89% of the time:	2.3%
90 to 99% of the time:	1.7%

II. Under <u>ideal</u> conditions, how would you divide your instructional time?

a. Demonstrations:

0 to 9% of the time:	31.6%
10 to 19% of the time:	50.3%
20 to 29% of the time:	15.3%
30 to 39% of the time:	1.7%
40 to 49% of the time:	1.1%

b. Discussion/Oral Reports:

0 to 9% of the time:	23.2%
10 to 19% of the time:	38.4%
20 to 29% of the time:	24.3%
30 to 39% of the time:	9.6%
40 to 49% of the time:	2.8%
50 to 59% of the time:	.6%
60 to 69% of the time:	.6%
70 to 79% of the time:	.6%

c. In-class Paper Work:

0 to 9% of the time:	41.8%
10 to 19% of the time:	32.2%
20 to 29% of the time:	22.0%
30 to 39% of the time:	2.3%
40 to 49% of the time:	1.7%

d. Laboratory:

0 to 9% of the time:	1.1%
10 to 19% of the time:	6.8%
20 to 29% of the time:	30.5%
30 to 39% of the time:	22.6%
40 to 49% of the time:	20.9%
50 to 59% of the time:	16.4%
60 to 69% of the time:	1.1%
70 to 79% of the time:	0%
80 to 89% of the time:	.6%

e. Lecture:

0 to 9% of the time:	9.0%
10 to 19% of the time:	18.1%
20 to 29% of the time:	26.6%
30 to 39% of the time:	13.6%
40 to 49% of the time:	13.0%
50 to 59% of the time:	15.3%
60 to 69% of the time:	2.8%
70 to 79% of the time:	1.1%
80 to 89% of the time:	0%
90 to 99% of the time:	.6%

III. In your opinion, to what extent do you think students change as a result of hands-on laboratory work?

	Percent of Students	
	60%	80%
Knowledge:		
They learn a lot	23.7	16.9
They learn some	15.8	5.6
They learn very little	2.3	.6
Skills:		
They increase lab skills a lot	23.7	23.7
They increase lab skills some	10.7	2.3
They increase lab skills very little	.6	0
Attitudes:		
Their attitude about the subject seems to improve a lot	23.7	29.9

	Percent of Students	
	60%	80%
Attitudes (Cont.)		
Their attitudes about the subject seem to improve a little	7.3	2.3
Their attitudes about the subject seem to improve very little	1.1	1.1

IV. What are major impediments in your situation in regard to laboratory activity for students?

	Major	Minor	No
Class size	10.2	27.7	62.1
Laboratory facilities	21.5	44.6	33.9
Laboratory equipment (non-expendable)	10.2	51.4	38.4
Laboratory supplies (expendable)	23.2	50.3	26.7
Length of class period	14.7	38.4	46.9
Amount of "trouble"	32.8	52.5	14.7
Safety factors	36.7	53.1	10.2
Teacher strain	38.9	39.5	21.5
Increases discipline encounters	43.5	41.8	14.7

V. The research on effectiveness of individual laboratory activity on a topic in comparison to demonstrations on the same topic shows mixed results. What do you think?

Lab work is more effective for nearly all topics: 29.4%

Lab work is more effective for many topics: 62.1%

Lab work is more effective for few topics: 12.4%

Lab work is more effective for no topics: 0%

VI. On the average, how much time per week do your students spend in laboratory (hands-on) activity?

0 to 19 minutes:	10.7%
20 to 39 minutes:	21.4%
40 to 59 minutes:	33.3%
60 to 79 minutes:	15.3%
80 to 99 minutes:	5.1%
100 to 119 minutes:	9.6%

VII. How much time per week do you think would provide maximum benefit to your students?

0 to 19 minutes:	7.3%
20 to 39 minutes:	1.7%
40 to 59 minutes:	15.8%
60 to 79 minutes:	13.6%
80 to 99 minutes:	7.9%
100 to 119 minutes:	21.5%
120 to 139 minutes:	16.9%
140^{+} minutes:	15.3%

University of North Carolina-Chapel Hill
Science Education

The Science Laboratory

Name _____

School _____ School System _____

Schedule:		#classes		#classes
	Biology (any)	_____	Physics (any)	_____
	Chemistry (any)	_____	Physical Science	_____

Number Years Teaching _____

I. How do you divide your instructional time each week (approximately)?

a. demonstrations ---------- _____%
b. discussion/oral reports ---------- _____%
c. in-class paper work ---------- _____%
d. laboratory ---------- _____%
e. lecture ---------- _____%
other ---------- _____%

II. Under ideal conditions how would you divide your instructional time?

a. demonstrations ---------- _____%
b. discussion/oral reports ---------- _____%
c. in-class paper work ---------- _____%
d. laboratory ---------- _____%
e. lecture ---------- _____%
other ---------- _____%

III. In your opinion, to what extent do you think students change as a result of hands-on laboratory work?

knowledge: they learn a lot ---------- _____%
they learn some ---------- _____%
they learn very little ---------- _____%

skills: they increase lab skills a lot ---------- _____%
they increase lab skills some ---------- _____%
they increase lab skills very little ------- _____%

(continued on other side)

attitudes: their attitudes about the subject seem to improve a lot ---------- _____%
their attitudes about the subject seem to improve a little ---------- _____%
their attitudes about the subject seem to improve very little ---------- _____%

IV. What are major impediments in your situation in regard to laboratory activity for students?

	major problem	minor problem	no problem
class size			
laboratory facilities			
laboratory equipment (non-expendable)			
laboratory supplies (expendable)			
length of class period			
amount of "trouble"			
safety factors			
teacher strain			
increase discipline encounters			

V. The research on effectiveness of individual laboratory activity on a topic in comparison to demonstrations on the same topic shows mixed results. What do you think?

lab work is more effective for nearly all topics ---------- _____
lab work is more effective for many topics ---------- _____
lab work is more effective for few topics ---------- _____
lab work is more effective for no topics ---------- _____

VI. On the average how much time per week do your students spend in laboratory ("hands-on") activity? _____ minutes

VII. How much time per week do you think would provide maximum benefit to your students? _____minutes

VIII. Can you estimate how much money, per pupil, that you have to spend each year for laboratory supplies, equipment and materials?

yes _____ : approximately $_____ per pupil

no _____

IX. How much money, per pupil, would you think is reasonable for your present situation? $_____per pupil